The JOURNAL of GEOGRAPHY

A Monthly Magazine Devoted to the Interests of Teachers of Geography in Elementary, Secondary, and Normal Schools

RAY HUGHES WHITBECK, *Editor*
Of the Department of Geology and Geography of the University of Wisconsin

VOLUME XVI APRIL, 1918 NUMBER 4

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$1.50 a Year THE JOURNAL OF GEOGRAPHY

Editorial Office—The University of Wisconsin, Madison

Send subscriptions and all correspondence regarding subscriptions, manuscripts and all correspondence regarding [illegible]

Entered as second class matter Sept. 5, 1916, at the postoffice at Madison, Wis., under the Act of [illegible]

The Journal of Geography

Published Monthly Except July and August

Successor to the Journal of School Geography, Vol. V, and the Bulletin of the American Bureau of Geography, Vol. II.

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PRICE—The subscription price is one dollar a year, payable in advance. Fifteen cents a copy.

POSTAGE IS PREPAID by the publisher for all subscriptions in the United States, Hawaiian Islands, Philippine Islands, Guam, Porto Rico, Tutuila and Samoa. Add 16 cents postage for Mexico and Canada. For all other countries in the Universal Postal Union add thirty cents for postage.

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APPLETON, WIS.

The JOURNAL of GEOGRAPHY

Volume XVI APRIL 1918 Number 8

MONTANA

By GRANT E. FINCH

Montana State Normal College, Dillon

BOUNDARIES and Size. Montana is the northernmost of the tier of Rocky Mountain states, touching Canada on the north and Wyoming on the south. It lies between North Dakota and a part of South Dakota on the east and the narrow northern arm of Idaho on the west. It is the third largest of the states (area, about 147,000 square miles), ranking next in size after Texas and California. Its shape is that of a parallelogram, irregular in boundary on the southwest, measuring 550 miles from east to west, and 275 miles from north to south. It is larger than all the New England states, together with New York, New Jersey, Delaware, and Maryland. The distance by rail across the state on one of the transcontinental lines is over 750 miles, or about as far as from Chicago to Philadelphia.

Mountains. Although Montana is a mountain state its eastern end extends far out into the Great Plains, so far that the traveler entering the state from the east has hundreds of miles to travel before he sees a mountain. There are a few scattering mountain ranges east of the middle line of the state and more numerous ranges on to the west, while the western third of the state is all mountainous. The main range of the Rockies crosses the greater portion of the state, well to the west; its general trend is northwest-southeast. It passes west of Helena and east of Butte. South of Butte it bends westward to the Idaho line and forms the Montana-Idaho boundary as far as Yellowstone Park. This range, known as the Continental Divide, separates Montana into two parts, the Pacific slope on the west and the Atlantic on the east, the latter being much the larger. A portion of Glacier National Park on the northern boundary drains into Hudson Bay. One high ridge in this Park is known as the "Triple Continental Divide." Montana is the only state in the Union which drains into three oceans.

The mountain ranges are numerous, probably fifty or more. They have in general a trend parallel to the main continental backbone. Among the ranges to the west of the Rockies are the Flathead mountains, the Mission Range—one of the most beau-

tiful in the state—and the Purcell, the Kootenai, the Coeur d'Alene and the Bitterroot ranges. East of the Main Range are, first, the Big Belt, Bridger, Madison and Gallatin ranges; beyond these, the Little Belt, Crazy and Absaroka mountains, and scattering ranges still beyond these. The highest peaks in the state are found in the Beartooth mountains on the southern boundary line, Granite Peak, 13,000 feet high, being the loftiest, and numerous others exceeding 12,000 feet in height. There are no elevated

Fig. 1. Emigrant Peak, Absaroka Range, and Yellowstone River. Courtesy Northern Pacific Railroad.

plateaus of any magnitude and the average elevation of the state is much lower than that of the states to the south (Montana, 3,900 ft.; Colorado, 7,000 ft.) The low points of the eastern and western boundaries are in the neighborhood of 2,000 feet and the railroads cross the continental divide at altitudes of from 5,200 feet to 6,300 feet.

Lakes. Most of the numerous lakes are of the small but beautiful Alpine type, though Flathead Lake, west of the Divide in northern Montana, is an exception, being 32 miles in length, the largest lake in the state. Ponds are numerous in some sections of the plains, particularly in the glaciated portion of northern Montana.

The non-mountainous part of Montana is a great plain which comprises more than one-half the total area. At the north the plains are fairly level where the Keewatin ice sheet smoothed

their surface. In the central and southern portions the plains are more rolling, with high divides, separating the drainage areas, which are sometimes deeply trenched and much dissected. In various parts, principally to the east, there are "bad land" sections whose extremely rugged topography is due to the rapid and uneven erosion of the soft underlying Tertiary and Cretaceous rocks.

Rivers. More than two-thirds of the state is drained by the Missouri and its tributaries. This stream heads at Three Forks, being formed by the union of the Gallatin, the Madison, and the Jefferson, whose fountain heads are in Yellowstone Park and in the mountain lakes and springs of the Continental Divide west of the Park. At Three Forks the Big Muddy is a clear mountain stream. It first flows northward between mountain ranges; north of Helena it passes through the "Gates of the Mountains," a gorge cut through the Big Belt Range, and emerges on the plains. Continuing its northerly course to Great Falls, it then turns sharply to the east and in seven miles drops by a series of falls and cascades a distance of 535 feet, and flows on eastwardly across the state in a deep and narrow valley. Its principal northern tributaries are the Sun, Marias, and Milk rivers. From the south it receives the Smith, Judith, and Musselshell rivers, and the largest of all its Montana tributaries, the Yellowstone. The Yellowstone rises in Yellowstone National Park and flows north and east for hundreds of miles, finally joining the Missouri a few miles over the state line. Important tributaries of the Yellowstone are the Clark's Fork, the Big Horn, and Powder rivers, all from the south.

The principal streams of the Pacific slope are Clark Fork (there are two rivers in the state bearing this name) and the Kootenai. Clark Fork rises above Butte and flows northwest ultimately to join the Columbia. It has numerous local names in its course in Montana—Yankee Doodle Creek, Silver Bow Creek, Deer Lodge, Hell Gate, Missoula and Clark Fork river—so that the decision of the Geographic Board that it be called Clark Fork throughout its length appears to be well founded. Its chief tributaries are the Bitterroot from the south, and the Flathead from the north. The Kootenai flows irregularly across the northwestern corner of Montana. It is a clear, beautiful stream with gravelly banks and a timbered valley. Both the Kootenai and Clark Fork have a greater minimum flow than the Missouri.

Fort Benton is marked on the maps as the head of navigation on the Missouri and in early days it was visited every season by numerous boats from St. Louis. Even the Yellowstone was once deemed a navigable stream. Now the only event in river naviga-

tion in the state is the annual pilgrimage of the Government "snag boat" up the Missouri.

The climate of Montana is characterized by the long winters and short summers due to its latitude (45 to 49 deg.) and its distance from the ocean. Shut off from the moisture-bearing winds of the Pacific by numerous mountain ranges and lying west of the path of the winds from the Gulf of Mexico, its rainfall is light and its percentage of sunshiny days large. It has an average annual rainfall of over 15 inches and an average crop-growing season of about 120 days. The state shows marked regional variations in its climate. Eastern Montana has the extreme of winter cold and summer heat of North Dakota while western Montana has the lower seasonal range of temperature of eastern Washington and northern Idaho. Northwestern Montana has the heaviest rainfall of any section of the state. Local variations in rainfall are very common. The mountain ranges, particularly their western slopes, have a good rainfall and even the benches along the mountain valleys and the high divides of the plains have more rain than the lower lands adjoining. An accurate rainfall map of the state would be as varied as the topography. The marked effect of altitude on climate, both temperature and precipitation, is not readily appreciated by dwellers in the prairies of the central United States.

Forests. About one-third of Montana is forested, the forests being confined to the regions of heaviest rainfall. Sections of northwestern Montana are continuously forested; elsewhere there is much open forest. Many mountain areas (lofty peaks and rocky or south-facing slopes) and many mountain valleys are devoid of forest growth, although lying within the forest regions. The plains are treeless except for fringes of willows and cottonwoods along the streams and dwarfed evergreens on some of the high divides. Coniferous species—pine, spruces, fir, and larch—make up the bulk of the forests.

More than one-half of the forests are included in the United States National Forests. Under control of the Forest Service important watersheds are preserved from denudation. Cutting is permitted only so far as it may be equalled by natural growth and deforested areas are replanted. A patrol system, aided by lookout stations, roads, paths, fire lanes and telephone lines, keeps down the fire waste.

Mines. The exploitation of the state was begun by the notable expedition of Lewis and Clark in 1805-07. It was very effectively continued by the fur traders and trappers who came immediately after Lewis and Clark. The gold seekers who thronged here in

the late fifties and early sixties completed the exploration of the state, and with their great discoveries of gold at Bannack (1862), Alder Gulch (1863), and Helena (Last Chance Gulch, 1864) the settlement and development of the state began. Montana began as a mining state and mining has always been one of its principal industries. Over $2,000,000,000 has been produced by its mines since they began to yield and the total mining output in 1916 was $145,000,000.

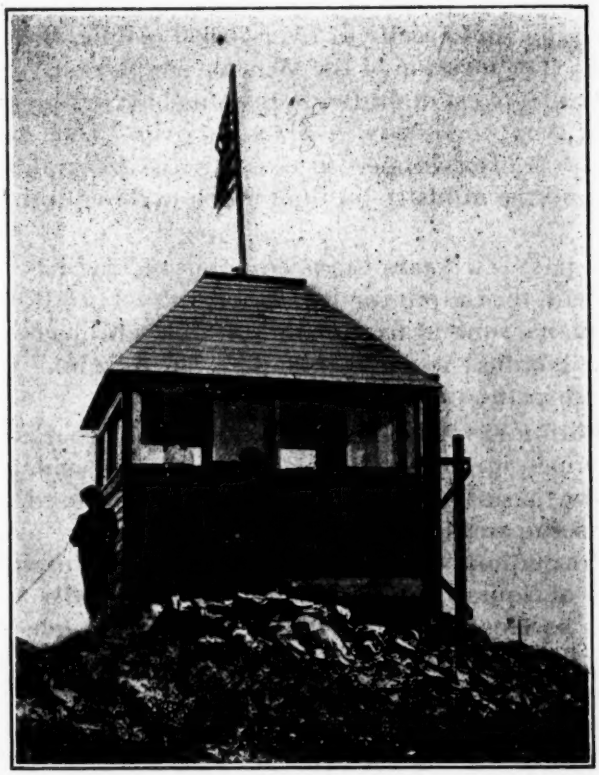

Fig. 2. Fire Lookout Station on Mountain Top, Western Montana. Photo by United States Forest Service.

The first mines were the placer "diggings," with their various systems of washing the loose gold from the gravel bars along the streams. The next step was the development of quartz—or deep-mining and then the production of silver was added to that of gold. The development of copper mining came with the building into the mining districts of the Northern Pacific railroad from the east and the Utah and Northern (now the Oregon Short Line) from the south.

Though the mining output of Madison, Lewis and Clark, and Jefferson counties and of Philipsburg and other mining districts

is important, the production of the Butte mines has for years overshadowed all other mining in the state. Within the environs of Butte is a high hill of eruptive granite, Anaconda Hill, which is known in Montana as the "richest hill on earth." The mineral veins of this hill attain in places a thickness of two or three hundred feet and through "secondary enrichment" a workable thickness of six hundred feet has been reached. Many of the veins have been followed down to a depth of over 3,000 feet without signs of exhaustion. About 15,000 miners find employment in the Butte mines, making Butte a city of over 70,000 people, the first in size in the state. The location of the Washoe smelter on Warm Spring Creek, 29 miles west of Butte, is responsible for the existence of the city of Anaconda, now a place of over 15,000 people. The Butte ores are also shipped to Great Falls, 150 miles away, for smelting, and the industry has had much to do with the growth of that city.

In the past few years the production of zinc has made great advancement, the output for 1916 being valued at $31,000,000. For years Montana ranked first in the production of copper but recently she has had to yield first place to Arizona. In 1916 she ranked first in the production of silver.

In addition to metal mining the mining of coal is also an industry of much importance. Coal beds are very widely distributed over the plains portion of Montana, their total area being placed by some authorities as high as 30,000 square miles. In the Tertiary formations of eastern and northern Montana there are thousands of square miles of lignite beds, usually lying at the surface or so close to it that the residents of each locality are able to dig their own fuel from the ground. Both semi-bituminous and bituminous coals of high grade are found in the Cretaceous coal beds of central Montana. The principal producing mines are those of the Red Lodge district of southern Montana and of Roundup and Lehigh in central Montana. In 1917 the total coal production was about 4,500,000 tons.

Grazing. Montana has for years held high rank as a grazing state. The native grasses are abundant and highly nutritious. These grasses cure on the ground, so that stock thrive on them the year around. Stock animals in the ordinary winters of light snows and frequent chinook winds are able to "rustle" on the range without feeding, but the percentage of losses is so high in case of severe winter storms that stockmen have generally taken to providing hay for their animals to be fed as needed. Cattle are even fattened for market in winter on hay alone, as in the Big Hole Basin in western Montana for example. While the raising of

horses and cattle is an important industry, it is as a sheep state that Montana takes highest rank. Sheep are better fitted to graze on the rugged lands and regions of scanty vegetation than are cattle, also better able to graze beneath the snow in winter. The favoring climate produces fleeces of good weight and high quality. The total number of sheep in the state is in the neighborhood of 4,000,000, giving Montana, next to Wyoming, first place in this industry.

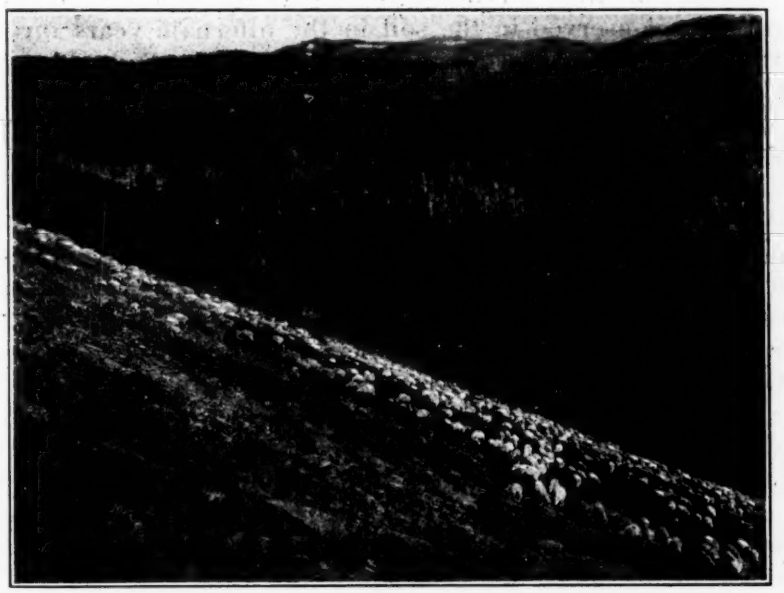

Fig. 3. Sheep Grazing on Forest Reserve. Photo by U. S. Forest Service.

The stockmen have in recent years suffered the loss of much of the open range land whose free use was so advantageous to them. However there yet remain millions of acres of land either too rugged or dry or inaccessible for farming purposes but still valuable for grazing, and in addition the seventeen million acres of Forest Reserves afford excellent summer range.

Agriculture. Farming by irrigation began at an early day in Montana in the mountain valleys near the mining camps with their excellent markets. With the coming of the railroads all the valleys which were susceptible of irrigation were farmed. As wealth increased capital became available for the construction of "high line" ditches to reach the fertile benches above the valleys. State and nation began to assist in projects—Carey Act and Reclamation Service—to bring the water to extensive tracts in cases where the initial expense was too great for private enter-

prise. The result of all these activities is the intensive farming of several million acres of highly productive land.

The total amount of irrigated land is so small (about 3,000,000 acres) that without other farming the industry of agriculture has seemed destined to remain a minor one in the state. In recent years, however, it has been found that crops can be grown without irrigation in many sections, thus greatly increasing the farming area and production. In some localities crops are thus grown every year; in others a crop is grown once in two years, the moisture being conserved in the soil in the alternate years through surface cultivation. Excellent results in this so-called "dry-farming" have been attained in many localities, such as the Judith Basin, Belt Basin, East Gallatin Bench, and Lake Basin in central Montana, Tobacco Plains in northwestern Montana and in the extreme eastern counties. Stimulated by these successes 35 million acres of land, more than one-third the area of the state, have been homesteaded for agricultural purposes during the past ten years, and one of the new counties reports 87 per cent of its surface under the plow. It is not to be expected that all the "dry farmers" will succeed. In sections where the factors of local variations in rainfall and evaporation or the capacity of the soil for retaining moisture are against them, the undertaking is a precarious one unless the homesteaders are possessed of sufficient means to tide over seasons of crop failure. Through the addition of dry farming production to that by irrigation the rank of Montana as an agricultural state has been raised from a place near the foot of the states to a rank above the middle.

The principal crops grown are the grains—wheat, oats, barley, rye and flax; hay—alfalfa, timothy, wild grasses; and potatoes, sugar beets and other vegetables. Corn is not grown to any extent, although a successful beginning in its production has been made in the Lower Yellowstone valley. Such fruits as apples, plums, and berries are successfully grown in the Bitterroot valley, the Flathead country and the Billings district.

The manufacturing industries of Montana are in the undeveloped stage common to the newer states. The sparseness of the population, the great opportunities for the laborer in other industries, the lack of nearby markets and of transportation facilities are some of the hindering causes. However the amount of manufacturing in some lines is by no means negligible. The reduction of ores provides employment for thousands of men at Anaconda, Great Falls, East Helena, and Butte. The manufacture of lumber is an important industry in western Montana, the annual output of the mills being over 400,000,000 feet. Flour mill-

ing has become important since the advent of the dry farmer, mills being in operation at Great Falls, Lewiston, Bozeman, and other points in the grain growing section. There are large beet sugar factories at Billings and Missoula. Manufactures of brick and other clay products are in operation at Great Falls, Lewistown, Helena, and Anaconda, and Portland cement manufactures at Trident and Lewistown.

Water Power. The rapid development of the abundant hydro-electric power is noteworthy. About 300,000 horse power has already been developed and new plants are being added at short intervals. The great centers of this development are at Great Falls and along the course of the Missouri through the Big Belt mountains between Great Falls and Helena. There are also large plants at Thompson Falls on Clark Fork and on the upper Madison river. The electric current is in extensive use throughout most of the state in domestic service and in mining, smelting, and other manufacturing, and in transportation. The main line of the Chicago, Milwaukee and St. Paul is operated electrically from Harlowton in central Montana westward across the state and on into Washington, a distance of about 450 miles.

The People. The population of Montana is a transplanted one which comes from almost all the other states. Only one out of three Montanans is native born. Numerous pioneers are yet living who came with the first gold stampede. About 25 per cent are foreign born. Notwithstanding the newness of the state its people show strongly marked characteristics, bred of their environment and fixed upon the inhabitants during the early days of mining and ranching. Among these distinctive characteristics are generosity and sociability. The penny has not yet come into general circulation and the people pride themselves on their indifference to paying high wages and high prices. The bricklayer gets $9.00 and the hodcarrier $5.50 for an eight-hour day. The long distances between ranches and between towns accounts for the sociability. Montanans are progressive, carrying out expensive schemes of improvement in less time than older and more conservative communities would take in considering how to make a beginning. Prosperity is on every hand. The wealth produced in 1916 from the mines, ranches, farms, and forests totalled $342,000,000, an average of $454 for each inhabitant of the state. The chief exceptions to the rule of prosperity are to be found among such homesteaders as have entered on their undertakings without means or experience or judgment.

Montanans travel much and are well versed in conditions in other communities and other states. There is much shifting from

the ranch to town and back again and the orders of society are in a fluid condition with democracy everywhere the rule. There are no cities of 100,000, six of over 10,000 and five between 5,000 and 10,000, so that conditions are for the most part rural.

There is little of the "wild and woolly" as depicted in the West of the movies. Gambling went out several years ago, the red-light establishments more recently, and the saloons are to go the first of January, 1919. The former activities of the picturesque cowboy have been greatly limited by barbed wire and plow, and sheepherding has lost much of its former loneliness. The honk of the automobile has supplanted the crack of the freighter's whip and though not so conservative Montana is fast becoming as regular in its habits as the average Eastern state.

Conclusion. The varied character of the resources of Montana is exceptional. Instead of being exclusively a mining state or a stockraising state or a farming state, Montana is prominent in all three and in addition has numerous other valuable resources, such as coal, timber and water power. The rapid growth in population is in keeping with the wealth of resources. Careful estimates place the present population at three quarters of a million, or double the population in 1910. For several years past the homestead entries (15,000-20,000 annually) have exceeded those of all other states combined, yet there are still large tracts unsurveyed. To the student of geography the appreciation of the natural resources of such a state and the observation of their development constitute a most interesting study.

The Highest Railroads in the World

It is a remarkable fact that among the railroads of the world constructed in part at very high levels above the sea, the eight which have to their credit the absolutely top figures are all situated in South America.

We append in tabulated form the highest altitude of each, the country in which situated and the name of the railroad.

15,865 ft.	Peru	Peruvian Central (Oroya)
15,814 ft.	Bolivia	Bolivia R. R. (Potosi)
15,809 ft.	Chile	Antofagasta & Bolivia R. R.
14,688 ft.	Peru	Peruvian Southern R. R.
14,108 ft.	Bolivia	Arica—La Paz R. R.
13,393 ft.	Bolivia	Guaqui—La Paz R. R.
12,000 ft.	Argentina	Transandine (Arg. Gov.) R. R.
11,841 ft.	Ecuador	Guayaquil & Quito R. R.

THE WEATHER FACTOR IN THE GREAT WAR: VIII* AUTUMN, 1917, AND WINTER, 1917-18

By Robert De C. Ward
Harvard University, Cambridge, Mass.

The Western Front

GEN. HAIG'S report on the operations of 1917 contains the following significant passages regarding the late summer and fall conditions:—"The Flanders offensive was maintained for three and a half months under most adverse conditions. The weather entailed almost superhuman exertions on the part of the troops of all arms. Despite the magnitude of his efforts, it was the immense natural difficulties, accentuated by abnormally wet weather rather than the enemy's resistance, which limited our progress. What was actually accomplished under such adverse conditions is the most conclusive proof that, given a normally fine August, the capture of the whole ridge in a few weeks was well within the power of our men. They advanced every time with absolute confidence in their power to overcome the enemy, even though sometimes they had to struggle through mud waist-deep to reach him."

It is almost impossible to imagine the difficulties of active military operations in a country covered with water-filled shell-holes; lashed by stormy gales; a slough of deep, sticky mud. The men stumbled forward, in the dark, and rain, and cold; struggling around or through shell-holes; floundering up to their knees, or deeper, in the mud; worn out with the physical strain; many drowning on the march, but advancing to do their duty. As Mr. Philip Gibbs expressed it in one of his graphic letters to the *New York Times*, "The victory is not to be counted so much in numbers of prisoners or in yards of slime as in the spirit of the humble men who worked with all their heart to the last beat against great obstacles and in very foul and cruel conditions. They won through, and that was the great victory." The stretcher-bearers who never faltered; the men who toiled against almost impossible odds to move the artillery forward; the aviators who flew under conditions formerly regarded as prohibitive—all shared in the glory. Many times military operations had to come to a standstill because of the weather. Military authorities acknowledged that the measure of British and French success was

* Previous articles in this series have been published in this *Journal* as follows:—Vol. 13, Feb., Mar., 1915, 169-171, 209-216; Vol. 14, Nov., 1915, 71-76; June, 1916, 373-384; Vol. 15, Nov., 1916, 79-86; Apr., 1917, 245-251; Vol. 16, Oct., Nov., 1917, 47-51, 86-90.
The present article concludes the series in this *Journal*.

almost wholly a question of weather. Progress was slow. The consolidation of positions gained was very difficult. Even the protection afforded by trenches was often unattainable because of the water-logged ground. The enemy clearly benefited by the bad weather. It was his best protection. In these trying fall months, every spell of good weather was taken advantage of to the utmost. The aviators, flying higher and having better visibility, were able more effectively to direct the artillery fire, and to drop their bombs with greater accuracy, while the drier ground made the movement of troops easier. On Oct. 7 the first snow of the season fell on the frontier heights of the Vosges, and "a cold wave" was moving over France.

The sudden and unexpected British "tank drive" on Nov. 20, in the Cambrai sector, was clearly planned to come during a spell of fine and dry, although cloudy, weather, which favored preparations for the attack. "It was ideal going for the tanks." A fog, combined with the smoke barrage, made observation practically impossible for the enemy aviators. As was to be expected during the changeable fall weather, this dry spell was almost immediately followed by heavy rains, snow flurries, and high winds—the usual autumn storms. Increasing cold, and biting winds, caused suffering to both men and horses, unprotected on the open lowlands. During the British withdrawal on Dec. 6, following the German counterattack, a fog provided protection. It was natural that this "drive," at an unfavorable season, should have led to renewed predictions that the campaign would be continued throughout the winter, and to the hope that the coast would be reached by spring. It was, however, not surprising to find these optimistic views of a continued Allied winter offensive, expressed at the end of November, soon giving way to the conviction that "the coming of winter will probably preclude any further considerable operations on the western front." As Mr. F. H. Simonds expressed it in December, "the interruption of winter makes it possible that the Germans may hold their present lines till Spring." The advance of winter brought more frequent and heavy snows with increasing cold. Despatches of Dec. 29 mentioned snows throughout France, as far south as Toulon, especially in the Vosges. Railway communication and motor transport were interfered with at intervals. On Jan. 11 a despatch noted: "This is the 26th consecutive day of frost and snow. The front is ice-bound. In the trenches every man not needed at the loopholes is under cover." Severe winter weather continued well along through January, interrupted by milder spells, which melted snow and thawed the ground.

The probable date of the expected German offensive was a matter of momentous interest. The Verdun drive was begun in late February, at a season meteorologically unfavorable, in order to forestall the expected British and Russian spring drives. Germany was severely handicapped by the weather. No real "winter campaigns" have been carried on in the western war zone. As a whole, the season of aggressive major operations has been April to November. Having in mind the general character of the weather of the western front, and knowing what part these conditions have played in the present war, it seems, at this writing, unlikely that the Germans will begin their drive until March or April, unless forced to it by the need of silencing popular discontent at home, or by some other political or strategic reason. Spells of warm, thawing weather come with increasing frequency in February and March, but unless the season is early, major operations are likely to be held up by storms and bad roads until spring is well established. The reports during February, 1918, mention fogs, heavy rains, and bad roads, but the increasing numbers of fine days, accompanied by drying ground, caused the Allied commanders to expect the German offensive earlier than had been originally anticipated.

The Eastern Front

The capture of Riga, serious as it seemed at the time, caused needless alarm regarding a possible advance toward Petrograd. It was never likely that the Germans would attempt such an expedition at a season when rains and bad roads, and later ice and snow, would certainly make such a movement difficult, if not impossible. Further, the coming on of winter, with the difficulties of navigation due to ice in the Gulfs of Riga and of Finland, made the possession of naval bases there by the Germans much less immediately serious, from a military standpoint, than many people supposed, and made any attempt on the part of the Germans to move farther east unlikely. It was probably the approach of winter, and not till later the political conditions in Russia, which made it possible for the Germans, even before the complete collapse of Russia, to transfer large bodies of troops from the eastern to the western front.

The German advance into Russia, following the failure of the peace negotiations, after the middle of February, brought up again the question of how far the Teutonic armies would penetrate into Russia at an unfavorable season. Mention was made (Feb. 24) of marches through snows. In view of the known climatic difficulties of snows, rains, and mud, the advance of the

Germans was likely to be difficult if the weather conditions were those of the usual February, March and April.

The Austro-Italian Front

Two phases of the war in this zone during the fall and early winter of 1917 need brief consideration: the remarkable Italian advance in September and most of October on the Isonzo front, and the Teutonic offensive, beginning in late October, 1917, which brought the invading armies well down onto the northern Italian plains.

Gen. Cadorna evidently pushed his troops to the utmost in the Carso Plateau region, in order to smash the Austrian armies, and to gain as much territory as possible before winter should make large-scale operations impossible. There were signs, also, that Italy was preparing for a winter campaign against Trieste when operations farther north could no longer be carried on. There were two classes of difficulties, both directly or indirectly meteorological, which added greatly to the already seemingly impossible task of the Italian troops. One of these was the problem of supplying water to the men who were fighting on the dry plateaus and on the high mountain slopes. Until pipelines could be laid, water was carried up, in small quantities, on the backs of men to the thirsty soldiers who could often look down thousands of feet onto the rivers running in flood far below them. The other difficulty was the stormy autumn weather. Heavy rains changed peaceful streams into raging torrents. Fogs and mists interfered with visibility. Increasing cold added to the discomfort and suffering.

The Austro-German advance began in the last week of October. The Italian front lines were broken through (Oct. 24th) "in a drenching rain and mist, under the most depressing conditions," which rendered the Italian barrage ineffective in opposing the onslaught. As one correspondent put it, "Austria is hiding behind the skirts of autumn." The Italian mountain positions "were surrounded and made untenable before the fog lifted." The use of deadly gases was favored by a light wind and the damp air. Several days of stormy weather were followed by a fine spell, which favored a rapid advance on the part of the Teutonic troops, across the mountains and through the valleys. During the early stages of their retreat, the Italians suffered greatly from cold torrential rains. Much interest centers in the stages of the Italian rivers. When these were running at flood, they served as obstacles to the advance of troops. When their waters were shallow, they could easily be crossed. The reports are con-

tradictory regarding the effect which the varying water-stages in these Italian rivers had upon the movements of the two armies. Sometimes the water conditions favored the invaders; sometimes they helped the Italians. It is clear that the high and low water stages have been a fluctuating factor in the military operations on their banks. The Piave was reported as flowing with a full head of water in mid-November. The rains which caused this high water helped to flood the lowlands. The sector of the lower Piave was further rendered more difficult to cross by the release, by the Italian engineers, of the flood waters through the opening of the dikes. A considerable area to the northward of Venice was thus submerged several feet. On Dec. 13 (1917) a report noted the occurrence of "downpours" for two days, filling the Piave, which had nearly run dry, and effectively flooding the inundated section over which the waters had fallen from 5 ft. to 1 ft. Taking advantage of this low water, the Austrians had made an advance.

After the remarkable Teutonic offensive, which brought the German-Austrian troops down onto the northern plains of Italy, and for a time seriously threatened Venice, military operations were suddenly and most aggressively renewed in the Trentino Alps. The enemy made desperate attempts to capture the mountain positions and to penetrate onto the lowlands, in order to turn the Italian left flank and make the Piave line untenable before winter should make such a task impossible because of snow blockades in the mountains. On the lowlands, the winter would not have interfered with an active Teutonic offensive. The Teutonic advance began "in driving snow, and cold, and pouring rain" (2d week of Nov. 1917). Bitter cold; lack of shelter owing to the terrific artillery action and the constant shifting of positions; insufficient supplies of water; the use of caverns and caves "from which hung huge icicles"; drifting snow; soldiers "compelled to remain for a long time motionless lest they should be discovered by the enemy against the whiteness of the snow"; biting winds—these are conditions mentioned in the official and other despatches. That the coming on of winter at once, and in earnest, with intense cold and deep snows, and raging "blizzards," and avalanches, would have been the best possible ally to the Italians, was well recognized by the military commanders. For in normal winter weather the Teutonic lines of communication both by railroad down the valley of the Brenta, and by the narrow mountain roads, would be paralyzed, or at least badly blocked; the transport of heavy artillery, of munitions and of supplies would be difficult or impossible. Each additional day that the Italians were able to delay the advance of the Austro-German

armies, brought winter's help one day nearer. Each day made the Teutonic offensive more difficult. It is easy to understand why the enemy general staff was ready to make such continuous and desperate attempts to break through before the worst of winter weather came on. They were fighting against time. The early part of the present winter (1917-18) was unusually favorable to the enemy. It was cold, but usually clear, and heavy snowstorms were entirely lacking. The snow, instead of being several feet (5-10) deep in the mountains, as it was a year ago as early as November, was up to about January 1, 1918, only a few inches deep in most places. A despatch of Dec. 6 said that one deep snowfall "would be worth divisions to the Italians." Gen. Diaz said on Dec. 9, "with normal winter conditions prevailing in the north, the enemy would now be in the grip of impassable snows." Several times the occurrence of light snowfalls was noted in the despatches, but the long hoped for heavy snows did not come. Small wonder is it that the Italians prayed for snow in the mountains, and for an end of what they termed "Austrian weather" which they felt had lasted ever since the first day of the retreat from the Isonzo front. It is natural that man should overestimate, or underestimate, the extent of meteorological conditions which are helping or hindering him in warfare. The deficiency of snowfall on the Alpine front during the early part of the present winter is, however, an established fact. Upon this point we have the statement of the major in charge of the meteorological work of the Italian High Command, as reported under date of Dec. 25, 1917, "This is one of the mildest winters we ever had."

The new year, however, brought an almost immediate turn for the better, for on the very last of December and continuing at intervals into January, heavy snows were reported as falling all along the mountain front. The depth of the snow soon reached several feet throughout the area, especially in the mountain passes and narrow valleys, where it drifted badly. The Austro-German troops were at once held up; food convoys stalled and trains from Trent, the great military supply depot in the Adige Valley, blockaded. These belated snows brought a new courage to the Allied troops, for the hope of the Teutonic invaders, of breaking through onto the plains, seemed to be definitely defeated, at least for the remainder of the winter. On Jan. 13, it was stated: "The Italian situation seems to present no cause for alarm." Transport is always difficult in the mountains, even under the most favorable weather conditions, but with roads and passes deep in snow, and in storms and blizzards, the task is often impossible. Thousands of soldiers in both armies were put to

work clearing away the snow so as to permit the steady movement of supplies. Huge tractor snowplows were used, and sledges replaced trucks for carrying food and munitions. The Stelvio Pass, through which goes the principal route to Trent, was blocked by 10 to 15 feet of snow. Farther east, also, the snows made trouble by blocking railway lines and passes, and causing avalanches. Large-scale operations were out of the question while the enemy's communications were snowbound. Severe winter weather also prevented military activity. The Italians had difficulties themselves, owing to the snows and the bad weather, but their enemies were far worse off. The enemy supplies had to be carried over high mountains, almost impassable, and the Italian batteries kept the roads, troops and transports in the rear of the enemy under continuous fire. By the middle of January, the invaders were in a very serious position, their communications having been "almost entirely cut off." Teutonic offensive operations in the mountains on any large scale were out of the question, and starvation stared the enemy in the face. In fact, shortly after the middle of January, the Austro-Germans retired on a section of their front between the Brenta and Piave Rivers. This retirement was doubtless due in part to a recent successful French attack, and in part to the difficulty of maintaining a continuous flow of supplies for the troops because of the deep snows. The Italians were in a much better situation, as their railroad supply lines come across the plains, where snows are light. Hence they were able to take advantage of the enemy's precarious position, and regained certain important "key positions" to the east of the Asiago Plateau. This winter offensive on the part of the Italians was carried out under great difficulties because of the deep snows.

The Balkan War Zone

From the Balkans there has been practically nothing of interest. Mention was made of the heat in Roumania early in September and early in October (1st) there were reports of the cessation of operations in Macedonia on account of the heat. On Sept. 25, the enemy released gas clouds, but a change in wind drove the gas back into their own lines. The first report of snow came Dec. 4, when it was noted as falling "abundantly" in the region of Monastir.

The Caucasus War Zone

Only one report has come of meterological conditions in the Caucasus region. This was under date of Sept. 20, and referred to four feet of snow in the mountains, where a battle was in pro-

gress between Russians and Kurds, at temperatures "below freezing."

The Campaign in Mesopotamia and in Palestine

Bagdad fell early in March, 1917. There was no fighting of major importance after April, owing to the intense heat of summer; to the collapse of Russian co-operation, and to the British campaign in Palestine. Reports have still been coming in of the sufferings of the British during the Kut campaign. One English officer wrote:—"Nothing that has been printed about the hardships of that ill-fated expedition came up to the conditions the men had to contend with. The water was thick with mud and unfit to drink, but it was impossible to keep some of the men from slacking their thirst, which resulted in their death by cholera. When I was down with fever the heat in my tent was 117 degrees, and there was nothing to eat but stodgy porridge. No medicines or medical comforts of any kind . . . . For hundreds of miles there was not a blade of grass, and no chance to get cover from the scorching sun or the enemy's guns. Flies gave us the most trouble in Mesopotamia, where they are worse than in any part of the eastern countries . . . . One fly out of every twenty appeared to be able to bite and inflict a severe sting."

One despatch mentioned the deaths of many British officers and men who, having surrendered to the Turks at Kut-el-Amara (April, 1916), were taken into the interior. The change from the intense heat of the Mesopotamia plains to the cold of a higher altitude, farther north, must surely have caused great suffering.

In Palestine, the British advanced rapidly as soon as the hot, dry summer was over. The capture of Gaza, of Beersheba, and of other less important towns, came during the autumn, when the weather is good for campaigning, being cooler than in summer, and not yet rainy. Gen. Allenby evidently planned to take Jerusalem before the December rains set in. At the end of November the official reports mention "heavy rains" and bright, cold weather. Jerusalem fell early in December. In regard to the capture of that city a correspondent reported:—"A torrential rain made the roads impassable while a chilly east wind pierced the sodden soldiers to the bone. The problems of supply and transport almost drove us to despair. The camels were unable to keep a foothold on the slippery paths. Nevertheless, the food and ammunition supply was maintained fully."

The capture of the Holy City meant much to the British. It meant a very strong line of positions gained. It meant an unlim-

ited supply of water. It brought the conviction that the backbone of Turkish opposition was broken.

On Jan. 2, 1918, Gen, F. B. Maurice said, regarding the situation in Palestine,—"A word of caution is necessary relative to the hopes of an immediate further advance in Palestine. The hills of Judea are notoriously difficult, the weather is unfavorable, and the roads impossible owing to the wet season. The transport problem, therefore, is likely to prevent any considerable movement there for some time." Nevertheless, the British advance continued. In spite of "heavy rainstorms, "mist," and "bad weather," the British moved eastward and on Feb. 21 captured Jericho. The rains made the hills "comparable only to masses of slippery soap."

The War in the Air

In so far as the ordinary airplane activity is concerned, it is clear, as has before been noted, that what, at the beginning of the war, were considered weather conditions too unfavorable for flying, now no longer act as a deterrent, although they render the task of the aviators infinitely harder. Flying is just as difficult as ever in gales, in low clouds, and in heavy rain, but flying is done then. We read, e. g., (Oct. 9) "In the stormy weather of these two days air work has been exceptionally difficult and perilous, but the French aviators carried out as far as it was humanly possible, and with the utmost gallantry, their essential tasks." Inability to take photographs of the progress of the artillery preparation is one of the serious handicaps due to fog, low-lying clouds, squally winds and rain. During the British offensive in the Cambrai sector, late in November, particularly good airplane work was done under unusually difficult weather conditions, especially in gales, and under low clouds, when the aviators had to fly very near the ground. Spells of fine weather were always accompanied by increased activity in the air. On the Italian front a fleet of enemy airplanes took advantage of a hazy spell (Dec. 27) for an attack over Treviso.

As regards the use of Zeppelins, it has been stated, on good authority, that "the superdirigible may now be considered practically weather-proof. Its vastly increased speed has put at its disposal a dynamic lifting or depressing force which in amount almost rivals the total lift of the gas. Easily compensating the ordinary fluctuations of the gas lift, due to barometric conditions and changes in temperature, it resists far more formidable agencies like rising or descending air currents, impact of rain or hail, and even weighting of the hull with water or snow. That speeds of over sixty miles per hour permit its slow return to shelter

against adverse gales is as obvious as that its increased radius of action will make this slowness of return no bar to safety."

Raids on England were only moderately successful. On Sept. 4 the first moonlight raid over the London district occurred, in a slight haze which made the enemy difficult to see. On Sept. 30, there was another moonlight raid, also in a "slight mist;" but without clouds or wind. The most sensational air attack, towards the end of October (20th), resulted in the destruction or capture of four Zeppelins in France. These were returning from England, and had formed part of a squadron of ten or more. Reports mention that a strong NE wind prevented the Zeppelins from returning to their bases at their best speed. Other reports speak of their having lost their bearings in a fog. "Just as the aviator of today fears only the fog, so super-Zeppelins have just fallen prey on the wholesale, not to adverse winds, but to impeded vision. In the heavy mist they blundered, *in daytime,* into an enemy's country bristling with air defenses." On Oct. 31, during another raid, "mist and many light clouds gave the invaders an excellent chance of concealment." A raid over the southeast coast on Dec. 6 was made in "ideal weather for raiders." The moon was extremely bright in a clear sky, and no breeze was blowing." The long period of over a month without raids was probably due to the unfavorable weather which prevailed. On Dec. 18 an air raid on London was unexpected, "as the new moon gave very little light and there were intervals when the sky was clouded." It was thought that perhaps the raiders reckoned upon the help of light reflected from the snow which lay as a thin coating over the raided area. A raid on London on Jan. 28 was made on a night of "absolute clearness. There was a full moon and no clouds or wind." Two long parallel lines of captive observation balloons ("sausages") now stretch along the two opposing lines of trenches, from the North Sea to Switzerland, except when the wind is blowing so strongly as to make ascents impossible, or very dangerous.

The War at Sea

On Sept. 5, during "a thick mist," a German submarine bombarded Scarborough. A German attack on Dover was made (Feb. 14) in thick weather on a very dark night. The men of the American fleet were reported early in October as having been furnished winter clothing, including supplies of the extra heavy garments which British experience on their vessels during the stormy weather of the northern European winters have taught them to be necessary.

GEOGRAPHY MADE REAL BY FIELD STUDY*

By Jennie Hall
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BEFORE discussing any form of teaching, we must first answer the question,—Why do we teach? To introduce and acquaint the child with that great heritage that civilization constantly leaves behind in the way of interpretation and application of Nature's few great but simple laws. Our task is a huge one, especially when we consider that all this realm of knowledge must flow into the human mind from or by means of experience only.

We talk of laboratory work, field work, text-book work, etc., as though they were things apart and separate. Not so,—all real teaching is laboratory or field teaching, if laboratory or field work means actual contact with the thing or principle studied, and no true teaching can be other than laboratory or field. It is contact study, contact of mind with matter or principle that governs matter and without this contact the mind can not grow. This law is as certain and definite as the law of gravitation.

If I teach within the four walls of a room and bring into that room every possible illustration of the subject being taught, explain, talk, study, apply those illustrations with my pupils until they become a part of each one's mind, the science teacher will say—"that is laboratory work;" the psychologist or training teacher will say—"that is supervised study or socialized study or humanized study," and I am privileged to call it field study, for what does it matter whether I take my class into the field, or bring the field to my class, if one is more convenient than the other, as it often is? I should like in this paper to discuss field work in this great, broad way for I do insist that it is all the same, but my time is too short to do justice to the complete subject so I shall include only that part of the work done outside our school room.

Then, first, why take the child out? We constantly hear that the interest in science in the High School is decreasing, Physical Geography is on the wane; we must admit that it is not the fault of geography, but of its presentation. I am confident that so long as there are boys and girls, there will be interest in any and every subject that is made interesting. It is not the subject matter, nor the text-book, nor the boy or girl that makes the interest, but it is

* A paper read before the Geography section of the Wisconsin State Teachers' Association, Milwaukee, November, 1917.

the teacher. It is the question of who is master—subject, book, boy, or teacher.

We, as teachers, must recognize the fact that the normal boy and girl is verifying the law of variation—that the youth of today is not like the youth of yesterday; whether better or worse matters not. If our normal subject of instruction is changing, our method must change and change at an equal rate. It is not easy to change a method; it takes more time, brain and nerve energy, but reason demands the change. Our normal boy today is of several types, unfortunately all in the same school group—the pampered child of overfond and unwise parents, expecting amusement and coddling, good marks and little work; the carefully guided child of other fond and wise parents, full of information resulting from much reading and seeing, always ready to advance and learn; the unguided child without initiative, using memory with good and bad results; the unguided child, with initiative familiar with all the town, shop and street can offer. These and still other types—boys and girls—are congregated into a group because they accidentally have advanced at the same rate in our public schools, and are called a class and given us to teach.

It does not take a psychologist to know that something is wrong, but all that matters not. While the psychologist is learning to regroup and resolve our problem, we have the group to teach. At present the problem is ours. We must get results, without friction. How?

One of the greatest hindrances to results is the habit of memorizing, learning what the book says, reading only lines, not between the lines. The page of the book makes no impression on the brain, a definition is only words. The normal boy glances at the lesson telescopically and then kills time. The normal girl either does nothing or reads microscopically, focusing only on the printed words, and recites phonographically. But if interest in the subject matter is first awakened by experiment or observation or illustration, then the book used, interest, thought controls, not memory. Impressions are the result, not mere traceries.

I would divide field work into problem and illustrative. A concrete example will best illustrate what is meant by problem work. For instance, before studying stream formation, I would take a group through a small stream bed, looking for the work of the water, using no names, but noticing where the pebbles and sand were deposited, where banks were cut, small rapids, falls, curves, etc., questioning as to reasons. Then I would give this group the test, asking them to find descriptions corresponding to what they had seen, and reasons for the same. Immediately the

text becomes a puzzle; every illustration is studied with interest and even the diagrams and graphs mean something. This book study I would follow with a second field trip to the same or new fields for verification and identification of name and formation. Practically all of Physical Geography can be studied in this manner.

I would include under illustrative work the visiting of factories, business firms, quarries, etc. Much of Commercial and Industrial Geography can be done in this way.

In the problem work, the small towns have a decided advantage for there man has not meddled with nature, and it is but a short distance to fields rich in material. On the other hand, the cities offer many times the opportunities for illustrative work.

Numerous questions naturally come to the teacher regarding field work, such as—When can we do it? How find time for it? What about discipline? All of these are serious questions requiring much judgment, wisdom, tact and planning, for if not wisely answered in the teacher's mind before attempting the work, failure is apt to result.

The ideal time, of course, is within school hours, though this is not always possible for the time is too limited. If the program can be so arranged as to give the last two periods of the day to the work, it is ideal. I have found little trouble in getting the pupils to do the work after school when necessary. In such an event equivalent time was given them from recitation or laboratory periods. When the pupil for any reason feels that he can not go out of school time, I have been in the habit of assigning him so-called equivalent reading to report on. Usually such pupils have found a way to join the class, often at the last moment.

The argument might occur to some that this sort of work takes more time, and that already too much is required in a given time. To such I would say that it has been my experience that the interest is so much greater, the impressions so much stronger and the knowledge so much more certain that time is saved rather than lost.

Regarding discipline:—In field work, as well as class room and laboratory work, interest takes care of discipline; it is the idle, uninterested boy who becomes a nuisance; so in field work the secret of discipline is plenty of work. The teacher should know her field absolutely and the route to the field should be very definite. An excellent opportunity is given for a good lesson in civics in connection with field trips—teaching the pupils the rights of property owners and the function of the school as well as the debt of the pupil to the state. A very definite outline of the

study expected, should be given to the pupils and a very thorough recitation with possibly a written exercise should follow. Care must be taken not to include too much in one trip, but to get the little very thoroughly. The groups should be small enough to be able to gather about the teacher and hear all that is said. A larger group becomes uncontrollable. I have found that the discipline is easier and the interest greater in seggregated classes, —boys, as a rule, are not interested in the same subjects that girls are, and their interest in the same subjects differ. The boy becomes restless through the necessarily long explanations that have to be made to girls.

It has been my custom to allow entire freedom on the outgoing trip to the field of study, requiring only that the group keep together near me, ready to stop and listen at a signal. When the field of study has been reached, I require the conversation to be strictly relative to the subject; note-books are taken out and outlines followed. At a signal from me, pupils gather for any remarks or directions or explanations I may wish to make. I then hold myself ready to answer their questions or guide their study. The lesson over, if out of school hours, I dismiss the class, letting each go home his own way.

In visiting factories, etc., I have found it best to go over the ground first, making arrangements and letting those who are to show the class about know what I most want the boys and girls to know and see. I have found business men more than ready and glad to give time and attention to this work.

What does field study do for the pupil? It does all that we most want to do, induces responsibility; for each one must solve his own problems and control himself throughout the trip; reliability, for he finds that he can solve his problems, and he becomes more reliant and self-respecting; individuality and originality, for the work is independent; moreover it gives a greater opportunity for real contact between teacher and pupil which reacts upon both, if the teacher is a true teacher.

It has been my experience that even the most troublesome children become less troublesome after such a trip, that classroom attitude and spirit are improved, that interest is stimulated, that teaching becomes more of a pleasure. In short, I am confident that no substitute for actual field study can bring the results that field study brings.

Possibly a part of the benefit comes from the contact with God's wonderful sunshine. Maybe the inocculation of our souls with that sunshine renews something within us. Often, when out on these trips, ideas such as these run through my head:

Build ye a city oh men,
Build ye a city fair,
But forget ye not, the soul must live,
And keep for us, here and there,
A plot of grass, a towering tree
Where over our heads, we, skies may see
And silvery stars on high.
Build ye a city oh men,
Build ye a city fair,
Our bodies needs must live by bread
But keep for us, here and there,
The good brown earth—the boundless sky—
Lest our souls ahungered, grow faint and die
Mid thy towering city fair.
Build ye a city oh men,
Build ye a city fair,
Build Gothic arch and marble hall,
But keep for us, here and there,
A plot of green, a waving tree,
Where, in times of stress, our souls may see
The light, for thy city fair.

SOME RESULTS OF THE LOCATION OF AUSTRALIA

By Stephen S. Visher
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THE location of Australia has largely determined its climate, has greatly affected its commerce, and has had a powerful influence on the character of its biota and population.

Effect of Latitude. The location of "The Island Continent" in latitude, mostly between the 15th and 30th parallels of south latitude and nearly bisected by the Southern Tropic, puts most of the area in the Trade Wind Belt. Since Trade Winds blow towards the Equator, from the south-east in the southern hemisphere, and hence into warmer and warmer latitudes, they are able to hold more and more moisture as they advance, and therefore normally are drying winds. Only where they are cooled by rising do they drop much moisture.

With the seasonal shift in latitude of the wind belts, the southern tips of Australia are reached by the Westerly Winds in "winter" (June-August), and are watered by them. These areas resemble Southern California in climate. Northern Australia is

in the Equatorial Belt in its summer, and receives copious convectional rains from moisture drawn southward by the monsoon winds which prevail there in that season. These winds blow towards the dry interior which is superheated then and consequently is a place of exceptionally low air pressure. Some northern coastal localities occasionally receive more than 100 inches of rain in their rainy seasons.

Effect of Mountains. The low range of mountains along the eastern coast of Australia profoundly affects the climate of a strip, perhaps 400 miles wide, but has relatively little influence on the climate of the rest of the continent. The much more rapid radiation, characteristic of even moderate mountain elevations, causes the warm, moisture-laden air, just off a warm sea, to become supersaturated, and it is compelled to drop a large share of its moisture. As a result, the rainfall varies on the eastern coast from 50 inches at Sidney, towards the south, to more than 80 inches in the warmer north. Soon after the summit of the range is reached, the air descends to lower altitudes and is warmed by compression. It thus becomes able to hold more moisture, which is proceeds to pick up by evaporation. Behind the windward mountains, Australia is dry. More than half the continent receives less than 15 inches of rain in an average year, indeed much of the interior receives less than 10 inches. Two thirds of the continent has no streams which find their way regularly to the ocean.

It is often assumed that the presence of this windward mountain range is responsible for the aridity of most of Australia, but this assumption is too sweeping. If there were no such range to rob the Trades of their moisture, most of Australia still would be arid, as are all fairly level stretches passed over by those winds. However if the winds hadn't already been so nearly deprived of their moisture, the few low elevations of the interior of Australia would cause more precipitation than they now do.

The Mild Temperature. Another result of the latitude of Australia is that cold temperatures are nowhere experienced, except in the higher mountains. Indeed all the continent, except the higher elevations towards the south, is practically free from killing frosts. Consequently pastoral pursuits and other out-of-door activities are not interfered with by cold. The livestock require no shelter from the cold. Hay is used in times of drought rather than of cold. Australia is "the land of picnics" partly, no doubt, because weather conditions are so favorable. It also has a remarkably low death rate (10.6 per 1000 of the population), doubtless partly due to climatic reasons.

Products. Since Australia extends from the truly tropical

regions to the 38th parallel, it is possible to grow a very great variety of products in the continent. Some of the many plants and animals which have been introduced do even better, in some respects, than in their native homes. For example, the highest price paid for wool is for Australian wool, and the highest price paid for wheat is for Australian wheat. Grapes do remarkably well in some sections, while an American cactus plant, the English rabbit and the fox find conditions congenial over wide areas.

Influence of Isolation on the Biota

The isolation of Australia since the dawn of the Age of Mammals, separated from Asia by the famous "Wallace's Line" through the East Indies or by wider belts of water, produced several highly interesting results.

Most people, when they think of Australia, recall the kangaroo. These animals are fundamentally different from the mammals with which we are familiar. One striking difference is that the young are born at a very early stage in their development, and placed in an abdominal pouch by their mother. The land mammals of Australia, except the bat and introduced forms, are closely related to the kangaroo and represent the lowest class of mammals, a class which is now practically extinct in the rest of the world, the opposum being the most notable exception.

While Australia had land connection with the continent of Asia, reptiles and birds of many sorts, and other lowly animals, and finally the most *primitive* types of mammals, established themselves. Since that remote date, the mammals of the rest of the world evolved amazingly and the diverse forms such as the cat, cow, giraffe, elephant, seal, bat, and monkey appeared in the other continents. Australia, due to its isolation, knew none of these higher mammals until the arrival of civilized man; two important exceptions were the bat, which had flown across the sea, and a dog, which had been brought in by the bush-man when he came by boat, thousands of years ago.

The lowly mammals of Australia differentiated too, and it is interesting to find animals simulating many of the types developed, among the higher mammals, elsewhere. For example, there are native mammals which resemble in habits and outward form, mice, rats, squirrels, bears, cats, muskrats, woodchucks and weasels. Such a diversity of forms, so closely related (all being marsupials), is an eloquent testimony to the influence of environment, and the results of specialization in habitat. The animals corresponding to our woodchuck and our flying squirrel, for example, lived in corresponding environments and necessarily acted some-

what similarly, and hence came to differ in habit and form from their relatives in much the way that our woodchuck and our flying squirrel differ from their relatives.

Not only were the native mammals peculiar, but many of the birds and most of the plants are too. Many of the latter are related, as in the case of the mammals, to forms now extinct in most or all the rest of the world. The characteristic tree of Australia is the eucalyptus. There are more than 300 varieties represented, adapted to nearly as widely different conditions as occur on the continent. In a land where there are no oaks or willows, some kinds of eucalyptus grow like oaks and some like willows; some grow where almost no rain falls, while others grow where there is very much. The "blue-gum," extensively introduced into California and Tropical America, in favorable localities grows to be more than 300 feet tall; some indeed, reaching 400 feet.

Influences of Remoteness on Commerce

The remoteness of Australia from Europe, Asia and other important land areas had great significance in its exploration and development and still influences its commerce powerfully.

The voyage from San Francisco to the nearest great port of Australia (Sidney) still requires nearly four weeks, while 35 days are commonly taken in the trip from England, going round Africa, and often more than seven weeks are occupied in going the 11,000 miles from England to Australia via the Suez Canal.

As two-thirds of the population of Australia is in the southeastern one-eighth of the continent, most of the people are 6,500 miles from Africa, 7,500 from South America, and about 4,000 from Asia.

Australia's exports are mainly products in active demand in the home country, and until the advent of refrigeration, they consisted largely of non-perishable products, and until recent decades, of products which were quite valuable per pound. Wool, hides, and precious metals long were the great exports. When efficient refrigerator ships were available, chilled meats, butter, and cheese were sent in increasing amounts to help supply the great British demand. Lately much meat has been exported, also. Now there are several hundred million bushels of wheat, purchased by the government from the farmers, stored in Australia awaiting shipment. Since it takes three times as long to take a cargo of wheat from Australia as one from the eastern United States, and since the submarine risk, around Spain, is estimated to be twice as great, the immense distance and the high freight

rates which the submarine has produced, bar so cheap a commodity as wheat, as it was barred in the days before the advent of numerous great, efficient, steel boats.

Influences of the Remoteness on the Development

Australia is so remote that it was discovered after most of the so-called New World was explored, and first settled in 1788, and then as an indirect result of the American Revolution with consequent closure of established penal colonies.

The remoteness resulted in immigration mostly of three sorts: penal colonists in the beginning only; immigrants of the laboring and servant classes brought over by wealthy land holders; and those who came of their own free will. The last class, far the largest, mostly were exceptionally daring, optimistic and independent, for only such would be likely to undertake so trying and expensive a trip as emmigration to Australia or New Zealand two generations ago entailed.

The fact that relatively few came to Australia, the great need for labor to develop the continent's resources, and the numerous opportunities to rise out of the laboring class, combined to make the labor problem a serious one and led to systematic attempts to encourage immigration of desired sorts, to higher wages and shorter hours, to legislation favoring the laboring class, to the introduction of American labor-saving machinery, and to other advanced procedures. The comparative remoteness, and the unreliable rainfall, also made it difficult to secure the capital required to develop the abundant resources. Thus the governments themselves were led to borrow money and accomplished many note-worthy tasks which are left in most countries to individuals, such as well-drilling, subsidizing ("staking") prospectors, and fence-building, in addition to the less unusual railway, telegraph, and road extension and management.

It seems almost self-evident that the following contributions are in no small degree the result of remoteness and consequences arising therefrom as listed in the preceding paragraphs. Civilization owes to Australians or New Zealanders the private balloting booth, without which voting cannot be independent, state insurance, compulsory arbitration of labor disputes, old age and disability pensions, the best code of mining laws yet worked out, and the conviction that the government should do everything for the people that it can do more effectively than the people individually can do for themselves. The principles of old age and disability pensions were early taken up by Germany and thus are sometimes incorrectly credited to that country.

THE ORIGIN OF PETROLEUM POOLS

By Edward Steidtmann
University of Wisconsin, Madison

INFERENCES as to the origin of petroleum or oil pools are necessarily limited by the known facts regarding their nature and occurrence within the earth. Since new facts are constantly being added to this field, there can be no theory of the origin of petroleum for which finality may be claimed. This sketch aims to outline some of the leading facts relative to the nature and occurrence of petroleum, and to present a few of the important inferences regarding its origin which are current at the present time.

The Nature and Occurrence of Petroleum Pools

Petroleums consist of a variety of hydro-carbon compounds of a bewildering complexity of composition. They are not as heavy as water per unit volume. In color, they range from black to colorless. The darker varieties are heavier, richer in asphaltic constituents, and less valuable than the lighter colored, so-called paraffine oils. Practically all petroleums contain sulphur in some form, and probably all contain nitrogen.

Oil or petroleum pools are local accumulations of natural oils filling the fine capillary tubes, fractures, and other openings of certain relatively porous rocks at various depths beneath the ground water level. The waters underneath the oil are in some cases salty, in others fresh. Natural gases, chiefly hydro-carbon compounds, sometimes fill the openings of porous rocks above the oil. Gas is also known to occur without oil beneath, and oil is often unaccompanied by gas.

Capping the porous oil bearing rocks, there are less porous or impermeable rocks which prevent the upward escape of the oil. Its lateral escape is prevented by the same cap of impervious rock and by the pressure of the water. Downward, the oil cannot sink because the water beneath is heavier than oil. The occurrence of oil in porous rocks capped by impermeable rocks in such a manner as to prevent the upward escape of the oil is so universal that the scientific exploration for oil simmers down mainly to a search for favorable rock structures.

The world wide search for oil in recent years, which the increased demand for oil has called forth, has shown that the architectural forms of the porous oil-bearing rock and the impervious cap rock are exceedingly varied. Nearly every oil district pre-

sents a type or types peculiar to itself. The porous rock in some cases is a porous sand or sandstone; in others, a cavernous dolomite or limestone, or a porous volcanic ash, etc. The various kinds of impervious cap rock found include volcanic rock, shale, limestone, etc. A classic type of structure consists of porous layers of sediments overlaid by impervious sedimentary beds, the whole arched upward into a dome or elongated arch. The lateral dimensions of such domes and arches vary from less than a mile to a score or more miles.

Inferences as to the Sources of Petroleum

Animal and vegetable matter buried in the sediments of past ages is accepted as the source of petroleum by most students of the problem. The generation of the constituents of petroleum from organic substances is chemically possible. They have been produced artificially from animal and plant fats and from black carbon bearing shales, lignites, and similar rocks.

Organic matter in rocks of various ages is the most widely distributed, most abundant known substance which is capable of producing petroleum.

There is a remarkably constant relation between the weight and composition of a petroleum and the ratio of fixed carbon to hydro-carbons in the rocks of the region in which the petroleum occurs. Oils found in regions in which the hydrocarbons of the rocks are abundant as compared with the fixed or elemental carbon are dark, heavy and low in certain hydro-carbons known as the paraffines. Where 60% of the carbon of the rocks is fixed or elemental carbon, the oils are light colored, light in density and rich in paraffines. Such a relationship cannot be regarded as accidental.

Probably all petroleums contain certain nitrogen compounds which it is believed could only be produced from organic substances.

It has been suggested that petroleum came from the interior of the earth by the interaction of steam on carbides in the earth or from hydro-carbon compounds in the earth's interior. Both views are purely speculative since no one knows whether such compounds exist in the deeps of the earth.

Volcanic rocks have been inferred to be the source of petroleum since some dying volcanoes exhale marsh gas, one of the chief constituents of natural gas. Some recently extruded volcanic rocks appear to have exuded asphatic substances. The great Trinidad asphalt deposit is closely associated with hot springs, the evidence of volcanic activity. The volcanic hypothe-

sis cannot be wholly discarded. A great difficulty in accepting it as important is due to the fact that evidence of past volcanic activity is absent in perhaps the majority of known oil fields.

The Generation of Petroleum From Organic Matter

Petroleum is generated by bacteria from organic matter slightly buried under mud and water. It is not apparent, however, that this is the source of oil in commercial pools. It may be that this bacterial action is important in preparing the organic matter for distillation after deep burial in the earth.

High temperature does not appear to be essential to the generation of oil from buried organic matter since most of the rocks from which the oil is believed to have come do not give evidence of having been at a high temperature.

The dominant factor which appears to have controlled the generation of oil from the organic matter of rocks is pressures due to the contraction or wrinkling of the earth's crust. It has been pointed out that oils associated with rocks containing a high proportion of fixed carbon are light colored, light in density, high in paraffines, and vice versa.

The nature of both the oil and the fixed carbon content of the rocks occurring with oil are dependent on the amount of wrinkling and compression of the rocks in which they are found. A high proportion of fixed carbon to other forms of carbon is found only in rocks which have been subjected to a high degree of compression while under a great load or to volcanic action. Commercial oil pools are not known to occur in rocks in which the percentage of fixed carbon relative to total carbon content exceeds 70%. The best grade of oils seems to be found in association with rocks in which the percentage of fixed carbon is about 60%, total carbon basis.

Although a close relation between petroleum and earth deformation is established, the exact mechanics by which this is brought about has not been made clear as yet.

The Accumulation of Petroleum Into Pools

The accumulation of globules of petroleum widely diffused through the rocks into commercial pools seems to be controlled mainly by three factors:—(1) gravity, (2) conditions which permit the oil to migrate towards a certain region in the earth's crust, (3) a favorable rock structure which prevents the oil from escaping from the region to which oil has migrated.

Oil generated below the water level tends to rise since oil is lighter than water. Gravity is thus the propelling force. Its migration upward is influenced by the size of the capillary openings

in the rocks through which it must pass, the position of the most porous rocks, and in some cases the circulation of the water, temperature and other factors. Its migration may also have been influenced by the wrinkling or contraction of the earth.

Oil globules from a great thickness of rocks have been trapped and permanently held where an arch or dome-like cap of impervious rock or similar structure blocked their further progress upward and held them at some depth below the ground water level. Had they reached the air or the rocks, their dissipation by evaporation, transportation by water, or chemical changes would have been certain. The varied nature of these favorable structures under which petroleums have accumulated has already been alluded to.

NOTES FROM U. S. COMMERCE REPORTS

Abstract of the Census of Manufactures

THE most recent statistics of American manufacturing industries—which, unfortunately, under existing law, are compiled only at quin-quennial intervals—are those derived from the census of manufactures taken in 1915, and covering the industrial operations of the calendar year 1914. The most important of these statistics are contained in the "Abstract of the Census of Manufactures," issued some time ago by the Bureau of the Census, which presents, in convenient form, with an alphabetical index, all the information needed by the great majority of persons interested in the progress and development of manufactures in the United States.

This publication, which is issued in the form of a 722-page volume 9½ by 6¼ inches in size, bound in cloth, is not for free distribution, but may be obtained by purchase from the Superintendent of Documents, Government Printing office, Washington, D. C., at 65 cents a copy.

India's Position in the Cotton-Goods Trade

Of the countries that supplied India with its $215,096,915 worth of imported cotton goods in the fiscal year ended March 31, 1914, only Japan and the United States increased their trade in 1916, the former to the extent of about $700,000, and the latter by about $400,000. New emphasis is placed on the fact that India is the greatest cotton-goods market.

Of the cotton goods imported in 1914, England supplied $193,853,572 worth, Germany was next with $4,596,429 worth, Japan

following with $3,909,965 worth, Holland next with $3,440,207 worth, Italy next with $3,216,657 worth, Belgium next with $2,443,421 worth, Switzerland next with $1,218,995 worth, Austria next with $1,095,702 worth, and the United States next with only $848,961 worth.

Roughly, British India takes about 20 per cent of the total cotton goods exported by all the cotton-manufacturing countries of the world. The value of the annual imports of cotton piece goods into the port of Calcutta alone exceeds that of the imports of piece goods into any other single country in the world.

Bulletins Issued by Bureau of Fisheries

The United States Bureau of Fisheries has issued two bulletins giving statistics by months and by fishing grounds, respectively, of the quantities and values of fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1917.

The fishing fleet landing fishery products at Boston and Gloucester, Mass., and Portland, Me., during the calendar year 1917 included 493 steam and sail vessels. These vessels landed at Boston 2,962 trips aggregating 98,650,139 pounds of fish, valued at $5,166,440; at Gloucester, 3,074 trips aggregating 58,134,944 pounds, valued at $2,451,484; and at Portland, 3,248 trips aggregating 18,645,503 pounds, valued at $743,408. The total for the three ports during the year amounted to 9,284 trips, aggregating 175,430,586 pounds of fresh and salted fish, having a value to the fishermen of $8,361,332.

Exportation of Australian Frozen Rabbits

The exports of frozen rabbits from Australia has assumed large proportions. In the State of New South Wales alone 1,500,000 crates containing 24 rabbits each were packed for export during the year ended December 31, 1917, making a total of 36,000,000 rabbits, valued at $7,299,250. New South Wales exports comprise about 55 per cent of the total for Australia. The total exported from the Commonwealth was about 70,000,000, valued at $14,599,000.

Aside from rabbits being killed for food, millions are annually killed for their skins; also to rid the country of them as pests. Especially is this true in districts far from freezing depots or railways. There are about 50 depots in New South Wales, and about the same number in the other States, and there are five cold-

storage depots for export, with a capacity of about 600,000 crates, and about the same number in the other States.

Rabbits are trapped at night, and motor trucks belonging to the freezing companies collect them early in the morning, and deliver them to the nearest freezing works, where they are graded under Government supervision. They are then put into wooden crates and placed in freezing chambers, where they remain for nine days until frozen solid and ready for shipment.

The prices for the rabbits vary according to the distance from the freezing works, and the grades change from 12½d. per pair for specials, down to 3½d. per pair for kittens (very small).

Frozen rabbits are graded as follows: Specials, large blues, young blues, small blues, large seconds, young seconds, small seconds, and skinners (rabbits with skins off).

Increase in Burma's Rubber Production

Recently published statistics show that the rubber production of the seven leading estates of Burma during the first half of 1917 was 635,978 pounds as against 429,463 pounds for the corresponding period, and 445,150 pounds for the latter half, of 1916.

These estates turn out practically all the plantation rubber of Burma.

Oil Situation in South China

South China's trade in kerosene showed considerable improvement in 1917 over the previous year, imports into the Hongkong-Canton field amounting to 32,500,000 gallons, as compared with 27,500,000 gallons in 1916. Of the 32,500,000 gallons imported in 1917, 20,000,000 gallons (valued at $1,250,000 gold f. o. b. American port) were from the United States and the remainder chiefly from Sumatra and Borneo.

Japan Produces Excellent Wheat Crop

The actual wheat harvest of 1917 in Japan has been excellent, according to a report by the Department of Agriculture and Commerce, which is published by the Japan Advertiser. The prospect for 1918, too, is officially stated to be very good.

The exports of soya-bean oil from Darien, Manchuria, to the United States increased from 44,966,930 pounds, valued at $3,057,370, for 1916, to 198,534,626 pounds, valued at $19,740,640, for 1917.

Condition of the Canadian Iron and Coal Industries

The growth of the iron and steel industry in Canada during the past 10 years has been phenomenal, this being more particularly true of the past three years. Canada has within its borders

or within easy access in Newfoundland, all the essentials, such as ore, coal, and the necessary fluxes, for the manufacture of iron and steel. The coal fields are located at relatively convenient distributing points, the ore fields are easy of access, and the steel plants, particularly on the eastern seaboard, are excellently situated for both domestic and foreign business.

The industry has been further stimulated by the entry of the United States into the war, thus shutting off nearly all exportation of steel to Canada except that absolutely necessary for war purposes.

Canada is slowly developing a shipbuilding industry. During the past year many new yards were built which are now turning out vessels of moderate tonnage. Old yards have been enlarged, and while the total steel tonnage produced during the year was small, the increased facilities will result in considerable new tonnage being floated during the present year. This industry will be a large consumer of steel. At present much of the material needed will have to be secured from the United States, as the Canadian mills are not equipped to furnish the shapes and sizes needed.

NATIONS THAT HAVE DECLARED WAR OR HAVE BROKEN RELATIONS

Declarations of War

Austria against Belgium, August 28, 1914.
Austria against Japan, August 27, 1914.
Austria against Montenegro, August 9, 1914.
Austria against Russia, August 6, 1914.
Austria against Serbia, July 28, 1914.
Brazil against Germany, October 26, 1917.
Bulgaria against Serbia, October 14, 1915.
China against Austria, August 14, 1917.
China against Germany, August 14, 1917.
Cuba against Germany, April 7, 1917.
France against Austria, August 13, 1914.
France against Bulgaria, October 16, 1915.
France against Germany, August 3, 1914.
France against Turkey, November 5, 1914.
Germany against Belgium, August 4, 1914.
Germany against France, August 3, 1914.
Germany against Portugal, March 9, 1916.
Germany against Roumania, September 14, 1916.
Germany against Russia, August 1, 1914.

Great Britain against Austria, August 13, 1914.
Great Britain against Bulgaria, October 15, 1915.
Great Britain against Germany, August 4, 1914.
Great Britain against Turkey, November 5, 1914.
Greece against Bulgaria, November 28, 1916 (provisional government).
Greece against Bulgaria, July 2, 1917 (government of Alexander).
Greece against Germany, November 28, 1916 (provisional government).
Greece against Germany, July 2, 1917 (government of Alexander).
Italy against Austria, May 24, 1915.
Italy against Bulgaria, October 19, 1915.
Italy against Germany, August 28, 1916.
Italy against Turkey, August 21, 1915.
Japan against Germany, August 23, 1914.
Liberia against Germany, August 4, 1917.
Montenegro against Austria, August 8, 1914.
Montenegro against Germany, August 9, 1914.
Panama against Germany, April 7, 1917.
Panama against Austria, December 10, 1917.
Portugal against Germany, November 23, 1914 (resolution passed authorizing military intervention as ally of England).
Portugal against Germany, May 19, 1915 (military aid granted).
Roumania against Austria, August 27, 1916 (allies of Austria also consider it a declaration).
Russia against Bulgaria, October 19, 1915.
Russia against Turkey, November 3, 1914.
San Marino against Austria, May 24, 1915.
Serbia against Bulgaria, October 16, 1915.
Serbia against Germany, August 6, 1914.
Serbia against Turkey, December 2, 1914.
Siam against Austria, July 22, 1917.
Siam against Germany, July 22, 1917.
Turkey against allies, November 23, 1914.
Turkey against Roumania, August 29, 1916.
United States against Germany, April 6, 1917.
United States against Austria-Hungary, December 7, 1917.

Severance of Diplomatic Relations

Austria against Japan, August 26, 1914.
Austria against Portugal, March 16, 1916.
Austria against Serbia, July 26, 1914.

Austria against United States, April 8, 1917.
Bolivia against Germany, April 14, 1917.
Brazil against Germany, April 11, 1917.
China against Germany, March 14, 1917.
Costa Rica against Germany, September 21, 1917.
Ecuador against Germany, December 7, 1917.
Egypt against Germany, August 13, 1914.
France against Austria, August 10, 1914.
Greece against Turkey, July 2, 1917 (government of Alexander).
Greece against Austria, July 2, 1917 (government of Alexander).
Guatemala against Germany, April 27, 1917.
Haiti against Germany, June 17, 1917.
Honduras against Germany, May 17, 1917.
Nicaragua against Germany, May 18, 1917.
Peru against Germany, October 6, 1917.
Turkey against United States, April 20, 1917.
United States against Germany, February 3, 1917.
Uruguay against Germany, October 7, 1917.

DEEPEST WELL IN THE WORLD

The deepest well in the world, already 7,363 feet deep, is now being drilled on the Goff farm, 8 miles northeast of Clarksburg, in northern West Virginia. Until January 24 the record for depth had been held by a boring at Czuchow, in Silesia, which had reached a depth of 7,349 feet.

Seven thousand three hundred and sixty-three feet is a very little less than one and a third miles. The depth of this well exceeds the height of Mount Washington (6,293 feet) and of Mount Mitchell (6,711 feet), the highest mountain in the eastern United States.

C. E. Van Orstrand, of the Survey, found that at a depth of 7,000 feet in the well the temperature is 152° Fahrenheit and that the rate of increase at this depth is about 1 degree in 51 feet of depth. This shows that the outer crust of the earth in this region is relatively cool, for in many other regions the temperature increases much more rapidly with increase in depth. Even at some places in the United States, according to unconfirmed observation, the temperature increases at the rate of 1° in a vertical distance as little as 25 feet, and that within a few hundred feet of the surface. Nevertheless, Mr. Van Ostrand estimates that the temperature of the rocks beneath the Goff well will be found at the boiling point (212° F.) at a depth somewhere around 10,000 feet.

RECENT PUBLICATIONS

CONCERNING CORNELL. By O. D. von Engeln, XVI+455 pages. Illustrated. Geography Supply Bureau, Ithaca, New York, 1917.

THE reason for referring to this book in the Journal of Geography is, primarily, that the volume includes a very excellent section dealing with the geography of the Ithaca-Cornell region. Furthermore, the book is written by Professor von Engeln of the Department of Physical Geography at Cornell. The book is a highly creditable work dealing with the history of Cornell University, the life of its founder, student life and activities in the institution, fraternities, athletics, and instruction. The lase two chapters deal with the geography and scenery of the beautiful Finger Lake region of New York. As a piece of book making, this volume is excellent. In every particular the work is artistic.

ORGANIC EVOLUTION. By Richard Swan Lull. The Macmillan Company, New York, 1917, pp. XVIII+729, 30 plates and 253 text figures. $3.00 net.

It is nearly sixty years since Darwin's Origin of Species gave scientific standing to the then theory of evolution. Today, it is no longer a theory; but probably the most fundamental fact of biological science. The ways in which evolution have been brought about, however, are still in debate. Much has been written relating to the mechanical processes of evolution and a wonderful wealth of evidence for evolution has been accumulated. Most of this material has been relatively inaccessible, not only to the general reader, but also to most students in other fields of scholarly endeavor, so that Professor Lull, in his Organic Evolution, has met a positive need. His many years experience in teaching organic evolution and his original investigations in that field have qualified him for the task of sifting and assembling the great fund of information and placing it in readable form.

The book consists of three parts. In part I are considered the development of the idea of evolution and the classification of animals and their geologic and geographic distribution. Part II deals with the mechanics of evolution and each of the different factors by which animals and plants may have advanced in development are clearly and fairly considered. In part III are given the evidences of evolution and here the author is at his best, as there has been available to him not only the discoveries of other investigators, but also the products of his own brilliant research.

The entogenetic and morphologic lines of evidence are fully considered, but particular emphasis is laid upon the evidence of paleontology and great surprise is in store for those who have not kept pace with the wonderful results which have come from the study of the fossils of extinct animals. In separate chapters are discussed the evolution of vertebrates and their emergence from the sea, the evolution of birds, mammals, elephants, horses, camels and man. The final chapter, entitled "The Pulse of Life" eloquently epitomizes the whole course of evolution.

The language of the book is simple and reasonably free from technical terms, so that it may be read with ease and pleasure, not only by the student of evolution, but by the general reader. In the reviewer's judgment, it is the best one-volume work on organic evolution which has yet appeared and it should be read by every one who is at all interested in the subject.

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